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Indian Standard

METHOD FOR DETERMINATION OF APPARENT SPECIFIC GRAVITY, TRUE SPECIFIC GRAVITY AND APPARENT POROSITY OF IRON ORE LUMPS AND SINTERS

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METHOD FOR DETERMINATION OF APPARENT SPECIFIC GRAVITY, TRUE SPECIFIC GRAVITY AND APPARENT POROSITY OF IRON ORE LUMPS AND SINTERS

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Indian Standard

METHOD FOR DETERMINATION OF APPARENT SPECIFIC GRAVITY, TRUE SPECIFIC GRAVITY AND APPARENT POROSITY OF IRON ORE LUMPS AND SINTERS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 25 November 1986, after the draft finalized by Ores and Raw Materials Sectional Committee had been approved by the Structural and Metals Division Council.

0.2 In recent years there has been a wide interest in assessing the quality of blast furnace burden and, as such, the conditions are being laid down to ensure requisite characteristics in the quality of raw materials. Apparent porosity of iron ore lumps and sinters is one of the important characteristic and this standard has been prepared for rationalizing the methods used for determining apparent specific gravity and true specific gravity for the determination of apparent porosity. The methods described here are equally valid for other minerals and may be applied when need arises.

0.3 IS : 5483-1969* covered the method of determination of specific gravity of iron ores, pellets and sinters. Since apparent specific gravity, true specific gravity and apparent porosity are the characteristics which are more realistic for ascertaining the quality of blast furnace burden, etc, the committee decided to publish a separate standard for the determination of these characteristics. Accordingly, IS : 11348-1985† was published for the methods of determination of these characteristics of iron ore pellets.

0.3.1 With the publication of IS : 11348-1985† and this standard, IS : 5483-1969* will stand superseded.

0.4 In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS : 2-1960‡.

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*Method for determination of specific gravity of iron ores, pellets and sinters.

†Method for measuring the apparent specific gravity and the porosity of iron ore pellets.

‡Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard prescribes the method for the determination of apparent porosity of iron ore lumps and sinters by the methods used for determining apparent and true specific gravity of iron ore.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions shall apply.

2.1 Apparent Specific Gravity — The ratio of the mass of iron ore sample to its apparent solid material volume.

NOTE — Sample is used, refers to iron ore lump or sinter.

2.1.1 *Apparent Solid Volume* — The volume of the iron ore sample plus the volume of the sealed pores of iron ore sample.

2.2 True Specific Gravity — The ratio of the mass of iron ore sample to its true volume.

2.2.1 *True Volume* — The volume of the solid material of an iron ore sample.

2.3 Apparent Porosity — The ratio of the volume of the open pores to the bulk volume, expressed as a percentage.

2.3.1 *Bulk Volume* — The volume of the solid material plus the volume of the sealed and open pores of the iron ore sample.

3. TEST APPARATUS

3.1 Glassware

a) Specific gravity bottle (50 ml),
b) 500-ml beaker, and
c) Water bath.

3.2 Balance — A laboratory balance having sensitiviy of 0·001 g.

4. TEST SAMPLE

4.1 The sample shall be representative of the material and shall be taken in accordance with the procedure specified in IS : 1405-1982* and IS : 11607-1986†.

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*Methods of sampling iron ores (*second revision*).

†Methods of sampling iron ore sinters.

4.2 The size of the sample shall be 1 mm to 2 mm for the determination of apparent specific gravity and 45 µm for the determination of true specific gravity.

5. PROCEDURE

5.1 Apparent Specific Gravity — The test shall be carried out according to the following procedure.

5.1.1 Find out the mass of the empty specific gravity bottle (M_1) and filled with distilled water up to the mark (M_2). Transfer about 5 g of sample previously dried at 108 ± 3°C (1—2 mm size) to the empty specific gravity bottle (if necessary dried) and weigh (M_3). Fill up distilled water up to the same mark and weigh (M_4).

5.1.2 *Calculation* — Obtain the apparent specific gravity (S_1) up to the third decimal place from the following formula:

$$\text{Apparent specific gravity } S_1 = \frac{M_3 - M_1}{M_4 - M_2}$$

In case the apparent density is required, S_1 has to be multiplied by the specific gravity of distilled water at 20°C.

5.2 True Specific Gravity — The test shall be carried out according to the following procedure.

5.2.1 Find out the mass of the empty specific gravity bottle (M_5) and transfer about 20 g of sample previously dried at 108 ± 3°C (45 µm) to the empty specific gravity bottle and wiegh (M_6). Add sufficient benzene to cover the sample and boil in a water bath by applying suction through a standard water tap for 20 minutes. Cool to 20°C and top up benzene up to the mark. Weigh the total content (M_7). Empty the bottle completely, rinse the bottle with benzene, fill it up with fresh benzene up to mark and weight (M_8).

5.2.2 Obtain the true specific gravity (S_2) up to three decimal from the following formula:

True specific gravity

$$\begin{aligned}(S_2) &= \frac{(M_6 - M_5) \times \text{Sp gr of benzene at } 20^\circ\text{C}}{(M_8 - M_5) - (M_7 - M_6)} \\ &= \frac{(M_6 - M_5) \times \text{Sp gr of benzene at } 20^\circ\text{C}}{M_8 + M_6 - M_5 - M_7} \\ &= \frac{(M_6 - M_5) \times \text{Value of Sp gr of benzene}}{M_8 + M_6 - M_5 - M_7}\end{aligned}$$

In case the true density is required, use the density of benzene instead of specific gravity in the above formula.

NOTE — Benzol, xylene or toluene may also be used in place of benzene. In the case of ores containing moisture, use of xylene or toluene is recommended.

5.3 Apparent Porosity

5.3.1 *Calculation* — Obtain the apparent porosity (P) percent from the following formula significant up to the first decimal place:

$$P = \frac{S_2 - S_1}{S_2}$$

6. NUMBER OF TEST AND PERMISSIBLE TOLERANCES

6.1 Duplicate tests shall be carried out on each sample of lump ore or sinter for apparent specific gravity as well as true specific gravity. If the difference between the two values falls within permissible tolerances given in **6.2** for both, the mean value shall be reported. If the difference exceeds this permissible tolerance, another set of duplicate test shall be conducted. If neither set of duplicate tests confirms to the permissible tolerance, all four values shall be individually reported and their average taken.

6.2 Permissible Tolerance — The difference between the two values in each set of duplicate tests shall fall within the permissible tolerances given below:

Lump ore	0·01
Sinter	0·03

(*Continued from page* 2)

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	1 N = 1 kg.m/s^2
Energy	joule	J	1 J = 1 N.m
Power	watt	W	1 W = 1 J/s
Flux	weber	Wb	1 Wb = 1 V.S
Flux density	tesla	T	1 T = 1 Wb/m^2
Frequency	hertz	Hz	1 Hz = 1 c/s(s^{-1})
Electric conductance	siemens	S	1 S = 1 A/V
Electromotive force	volt	V	1 V = 1 W/A
Pressure, stress	pascal	Pa	1 Pa = 1 N/m^2